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ALFALFA BACTERIAL WILT IN MICHIGAN

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SECTIONS of BOTANY and FARM CROPS

East Lansing

To Control Alfalfa Bacterial Wilt —

Many questions remain to be settled before definite measures for control of alfalfa bacterial wilt can be given. However, with our incomplete knowledge of the disease in Michigan and in the absence of adapted resistant varieties, certain practices may be recommended as beneficial:

1. Allow sufficient time for old infected alfalfa roots to decay before reseeding a field to alfalfa.

2. Seed alfalfa on high fields located so as not to receive surface drainage from infected fields.

3. Sow certified seed of winter hardy varieties from known sources.

4. Cut alfalfa when plants are dry. There is less danger of spreading wilt bacteria on the mower knife from dry plants.

5. If an infected field has been cut, disinfect the mower knife before cutting a wilt-free field. (Use 1 pint formaldehyde in 15 gallons of water for disinfecting the mower knife.)

6. Do not top-dress alfalfa fields with manure from wilt-infected hay.

7. The clovers are not infected by the wilt bacteria and may be sowed on old alfalfa soil.

8. Seeding smooth brome grass with alfalfa seems to reduce the spread of wilt in the field.

9. Avoid cutting for hay or close grazing after September 1, as this often increases winter injury and makes it easier for the wilt organism to gain entrance into the alfalfa plant.

Alfalfa Bacterial Wilt In Michigan

J. H. Muncie and C. R. Megee

During the past decade the acreage of alfalfa in Michigan has steadily increased until in 1938 more than a million acres of this crop were harvested. Grown for hay, seed and pasture and used as a soil-building legume, alfalfa is one of the most important crops in the state.

Alfalfa is subject to several diseases but until recent years none of them has been of extreme seriousness. However, the establishment of alfalfa bacterial wilt and root rot disease in certain southern counties and its recent rapid northward spread is cause for concern.

Many fields of alfalfa have died out within the last few years, the cause of which was not clearly understood. In many cases dying out followed winter injury, but in others this condition could scarcely account for the rapid deterioration of stands. Field surveys by the writers and specimens sent in by county agricultural agents and growers have established the fact that many alfalfa fields are badly infested with bacterial wilt parasites.

This bulletin is written to furnish detailed information to the grower regarding the disease and to suggest certain practices which will reduce losses to the crop.

SYMPTOMS OF BACTERIAL WILT

On the parts of the plant above ground the most conspicuous sign of the disease is wilting of the foliage. However, before wilting takes place, infected leaves may be noticed because of smaller size and slight to pronounced mottling or yellowing. Upward curling of the leaf-margin and drying out of affected leaves takes place. Infected plants often are stunted and for that reason are not easily detected by casual observation. Such plants often produce a large number of small weak stems, with mottled to yellow leaves giving the plant a bushy appearance.

The taproot of the plant is infected before wilting and yellowing of the foliage occurs. In early stages of the disease there are no outward signs of infection. However if the bark of the root is stripped

off, irregular yellowish to brown patches or yellowish slime will be seen along the woody cylinder of the root (Fig. 1). In older infections these patches may be light to dark brown in color. If the in-

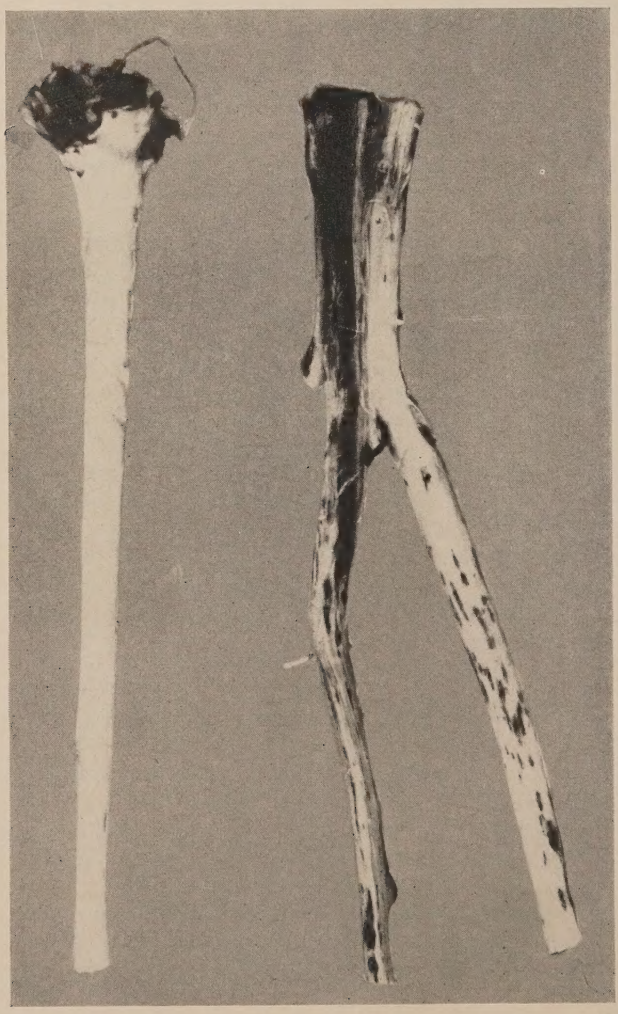

Fig. 1. Alfalfa roots with bark stripped off showing (right) yellow-brown discolored patches caused by the bacterial wilt organism; (left) healthy root.

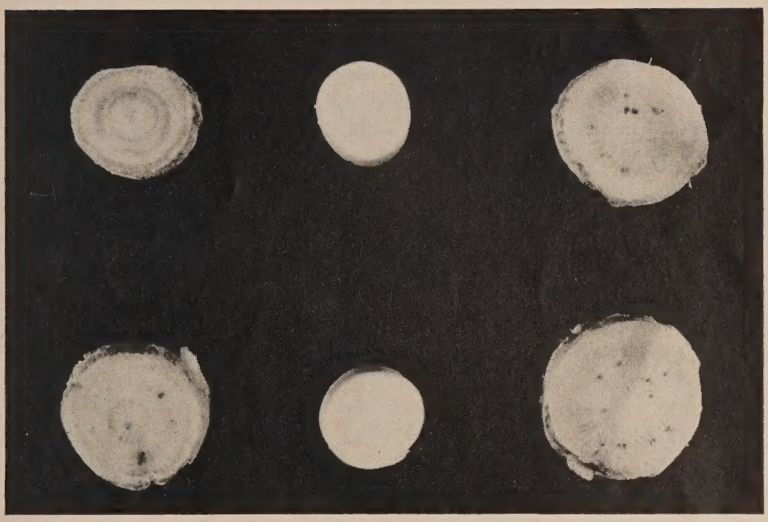

Fig. 2. At right and left, cross sections of bacterial wilt-infected alfalfa root showing discoloration of inner portions. In center, sections of healthy root.

fected root is cut crosswise, yellow to light brown flecks or dots are seen on the cut surface usually near the outer edge of the section (Fig. 2). In late stages of the disease, the root becomes badly decayed and the tissues are filled with a yellowish liquid which carries the bacterial wilt organisms and other rot-producing bacteria. Winter injury, although not necessarily a cause, may play an important part in early death of infected plants.

HISTORY AND OCCURRENCE OF BACTERIAL WILT

Bacterial wilt is not a new disease, having been known for several years both in Michigan and other states. It was first reported in 1925 from Michigan by J. E. Kotila* from Cass county. In 1923 it was found in Iowa (1)** and in 1925 the disease was reported by Jones (2) from Wisconsin and from Illinois where it was seen in 1921 and again in 1924 (4). The disease is now known to occur in the following states: Alabama, California, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Kansas, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Jersey, New York, Ohio, Oklahoma,

*U. S. Dept. Agr., Bur. Plant Industry, Plant Disease Reporter 9:110. 1925.
**Numbers inclosed in parentheses ( ) refer to publications cited on page 11.

Oregon, Pennsylvania, South Carolina, South Dakota, Utah, Washington, Wisconsin and Wyoming.*

In 1927, Kotila again reported the disease from Michigan in restricted areas of Cass, St. Joseph, and Van Buren counties. Since that time the disease has been confined largely to the southern two tiers of counties until in 1935 when bacterial wilt was found in Ingham County. In 1938 the number of reports and specimens received for examination indicated that the disease had rapidly spread beyond its original boundaries and was causing considerable loss on many farms. The disease is now known to be present in Calhoun, Cass, Cheboygan, Emmet, Eaton, Huron, Ingham, Kalamazoo, Livingston, Macomb, Manistee, Mecosta, Missaukee, Newaygo, Oceana, Otsego, Osceola, St. Joseph, and Van Buren counties. In all probability, bacterial wilt could be found by diligent search in many other counties in Michigan.

CAUSE OF BACTERIAL WILT

The disease is caused by the non-motile rod-shaped bacterium known as *Phytomonas insidiosa*. How the bacteria are carried to alfalfa fields is not definitely known. Circumstantial evidence points to the probability of their being carried in dust from broken infected stems adhering to the seed during threshing. Evidence so far (3) has failed to show that bacterial wilt is carried within the seed since seed from infected plants produced clean plants. Also infected plants usually do not produce seed.

The bacteria may enter the outer portions of the root through various kinds of wounds, such as those made by insects, freezing or root hairs breaking through the bark. Freezing injury probably accounts for much of the wounding. After the wound is made the bacteria are carried in by surface water. Once the bacteria have obtained entrance they find their way into the water-conducting system of the taproot. Here they multiply and, either because of their large numbers or production of a gummy substance which follows infection, clog the water-conducting vessels of the root. Laboratory tests in Iowa (6) and Colorado (5) show that upward water flow through infected roots is greatly hindered. This results in wilting of the plant. Invasion of the outer portion of the root eventually results in its decay and death of the plant. From the root, the bacteria pass upward into the stems where they become a source of infection to the field.

*Data supplied in correspondence by Dr. H. A. Edson, Office of Mycology and Disease Survey, Bureau of Plant Industry, U. S. Department of Agriculture.

SPREAD OF BACTERIAL WILT IN THE FIELD

Alfalfa wilt is usually first found affecting a few plants in rather small patches. It is more abundant in lower areas of the field where surface water drains. This applies particularly to the disease in young stands of alfalfa. After the first or second cutting, the disease usually becomes more widely scattered, especially in wet years. Jones and McCulloch (3) state that nearly all badly infected fields they have observed were found in areas receiving at least 25 inches annual rainfall. This fact may account for the appearance of the disease in widely scattered areas in Michigan in 1938 during a relatively wet year. These facts indicate that the wilt bacteria may be carried in surface drainage water and also on the mower knife during cutting of the crop. The disease has been produced on alfalfa plants in the greenhouse by cutting off the tops of healthy plants with a razor blade dipped in a suspension of the alfalfa wilt bacteria. Under these conditions, bacterial wilt symptoms appeared approximately 7 months after inoculation. Infected plants showed marginal yellowing and somewhat smaller leaves than the uninoculated controls. Cross-sections of roots of the infected plants showed some plugging of the vascular tissue. It seems likely, therefore, that the mower knife in the same manner could spread infection in the field.

PLANTS AFFECTED BY BACTERIAL WILT

In Michigan only alfalfa has been observed to be affected by the bacterial wilt disease. Jones and McCulloch (3) report finding the disease on white sweet clover which was seeded in an infected alfalfa field. They also produced the disease on white sweet clover by inoculating plants in the greenhouse. Sackett (8) reports both sweet clover and alfalfa are affected by the disease in Colorado. The common clovers and grasses are not affected by the disease. From this fact it is seen that medium red or June, Mammoth and Alsike clovers may be used in the rotation in place of alfalfa although these crops are of shorter duration.

It has been shown by Koehler and Jones (4) in Illinois that bacterial wilt was much more severe in fields sown to 15 pounds per acre of alfalfa seed than where 7½ pounds of alfalfa seed were mixed with timothy or orchard grass. The writers have observed that alfalfa sowed with smooth brome grass was less affected by wilt than an adjoining field sown entirely to alfalfa seed. This may be due to the smaller number of alfalfa plants in the fields seeded to the mixtures

and consequently greater difficulty of spreading the bacteria either in surface water or on the mower knife in cutting.

LONGEVITY OF WILT BACTERIA IN THE SOIL

It is not known definitely just how long the bacteria causing alfalfa wilt will remain alive in the soil. It is to be presumed that they will remain alive and probably be able to reproduce the disease as long as the infected old alfalfa roots are not completely decayed. It has been stated by Jones and McCulloch (3) that the bacteria remain alive in infected alfalfa hay at least 5 months. Whether they survive passage through the alimentary tract of animals fed on infected hay and remain a source of infection in manure is not known. Until experimental work has determined these points, it would be advisable to use manure from infected hay on fields planted to crops other than sweet clover or alfalfa. A rotation sufficiently long to insure complete rotting of all old alfalfa roots in an infected field also is advisable.

VARIETIES OF ALFALFA AFFECTED BY WILT

Apparently all the common alfalfas are affected by wilt. It has been our observation that both Grimm and Hardigan are readily killed out by the disease. Ladak in fields alongside Hardigan has shown less serious effects of the disease. In one field where practically every plant of Hardigan showed infection, many of the Ladak plants were free from the disease while those affected showed a smaller percentage wilted.

Following comprehensive tests under Nebraska conditions of seed collected by the Division of Forage Crops and Diseases, U. S. Department of Agriculture, Peltier (7) states that none of the commercial varieties and strains of alfalfa is completely resistant to bacterial wilt. However, alfalfas originating from a few old fields of Turkestan and Ladak including Hardistan and Kaw, which are probably strains of Turkestan, are much more resistant to bacterial wilt than is Grimm.

Seed of the Hardistan and Kaw is not available commercially. A limited supply of Ladak seed is available at a price slightly higher than that of Hardigan and Grimm.

In a variety test at the Michigan Agricultural Experiment Station at East Lansing, over a four-year period, the Ladak yielded 92% and Turkestan 84% as much air-dry hay per acre as the Hardigan. During that time there was no evidence of wilt present. From recent observations concerning the greater susceptibility of Hardigan to the

wilt, it appears likely that had wilt been present the Ladak would have shown a relatively higher yield.

Tests conducted in the northern Great Plains area show the Ladak to be superior to the Grimm and other variegated strains. Similar tests in the northern Corn Belt states indicate that there is but little difference between Ladak and Hardigan unless wilt is present and then the Ladak is superior.

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